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PUBLIC HEALTH REPORTS.

PLAGUE INFECTION IN SQUIRRELS.

Laboratory experiments have demonstrated that ground squirrels n be infected with plague, and a few cases of such infection have en reported.

On account of the great numbers of ground squirrels in California d other states, their infection, though quite limited so far as a ystematic search has revealed, has given rise to reasonable apprehension, and a knowledge of their habits and the best methods of destroying them is deemed of special importance.

Because of their devastating effect upon grain and other crops, the Biological Survey of the Agricultural Department has for a long time made a special study of these rodents, and Doctor Merriam, the Chief of the Biological Survey, has kindly responded to a request to prepare a bulletin giving the information necessary for dealing with these pests from a sanitary as well as an agricultural standpoint.

Attention is particularly called to his statement of the effect of the natural enemies of the ground squirrel upon their prevalence, as well as the proven methods of their destruction by artificial means. These observations have been the result of study and practical methods successfully utilized by the survey. As stated by Doctor Merriam, it is now a matter of importance, both from a sanitary, as well as an economic standpoint, that a systematic destruction of these pests should be entered upon.

CALIFORNIA GROUND SQUIRRELS.

By C. HART MERRIAM, Chief U. S. Biological Survey.

California is overrun with ground squirrels, no less than three genera and a dozen species occurring within its borders. These may be arranged in four groups: (*a*) the large, long-eared gray ground squirrels (subgenus *Otospermophilus*); (*b*) the small, short-eared brownish species (genus *Citellus*); (*c*) the small, white-striped antelope ground squirrels of the deserts (genus *Ammospermophilus*); (*d*) the golden-mantled ground squirrels of the mountains (genus *Callospermophilus*).

The ground squirrels rank among the most destructive of our native rodents, causing losses to agriculture amounting to at least $10,000,000 annually. In Oregon, Washington, Montana, and other parts of the West the most harmful species are the short-tailed ones, but in California the only ones of marked economic importance are the long-eared gray or "digger" squirrels. These are relatively large animals, about the size of the eastern gray squirrel, with upright squirrel-like ears and long bushy tails. Three species occur in the State: (1) The Beechy ground squirrel (*Citellus beecheyi*), which ranges from lower California northward to San Francisco Bay, and east of the Sacramento Valley continues northward to Lassen Butte and Susanville; (2) the Douglas ground squirrel (*Citellus douglasi*), which ranges from the north side of San Francisco Bay northward to the Columbia River; and (3) the Rocky Mountain or Plateau ground squirrel (*Citellus grammurus*), which enters California from the east and in that State is known only from the canyons of the Colorado River and the Providence Mountains on the east side of the Mohave Desert.

THE BEECHEY GROUND SQUIRREL.

The species of greatest economic importance, because of the extent of its range, which covers the greater part of the agricultural lands of the State; because of its destructiveness to grain, nuts, fruit, and other crops; and because of the recent discovery by the Public Health and Marine-Hospital Service that it is a carrier and disseminator of plague, is the Beechey ground squirrel. By reason of this new danger this animal has recently sprung into prominence and demands attention. The danger to human life by the spread of plague so far exceeds in importance the harm done by the destruction of crops that the duty of checking its increase is no longer a local matter but one of national concern.

The Beechey ground squirrel inhabits the open plains of the great interior valley of California, the grassy chaparral slopes of the foothills, and the rocky walls of canyons, and in places pushes up into the more open parts of the yellow-pine forests of the mountains. It lives in underground burrows, usually grouped in colonies. The colonies may be located on the bare, open plains, on the grassy slopes of foothills, or about the roots of trees. The burrows vary from a few to hundreds, and by the union of contiguous colonies sometimes reach a total of thousands and cover almost continuously hundreds of acres. The earth brought up from each burrow is deposited at its mouth, forming gradually enlarging hillocks, so that old colonies on the plain are recognizable at a distance by the mounds. The mouths of the burrows are connected by well-beaten paths, 2½ to 3 inches broad, which radiate from each hole and by intersecting form a conspicuous network, and many of the runways extend for considerable distances into the adjacent feeding grounds.

The animals are diurnal, and in the larger colonies hundreds may be seen at one time, some scudding swiftly over the ground, some rolling in the dust, some basking in the sunshine, and some standing erect on their haunches gazing over the country or biting off the stems of grain, tarweed, or other plants on whose seeds they feed. The seeds not eaten on the spot are tucked away in the cheek pouches and carried home to be kept in underground storehouses for future use. Acorns also are a favorite food and where obtainable are gathered and stored in large quantities. Of cultivated nuts, almonds and walnuts are preferred; of other crops, apples, prunes, peaches, certain garden vegetables, and all the grains are preyed upon wherever they are to be had, and alfalfa is sometimes eaten.

While living mainly on the ground these ground squirrels nevertheless are good climbers, and are often seen in the valley oaks and other nut-bearing trees, and also in fruit trees. They are not migrants in the proper sense of the word, their journeys being limited to short distances, as from one locality to a neighboring one, according to fluctuations of the food supply. Neither do they hibernate in winter, except in the mountains, although in the foothills and valleys they usually remain in their burrows during stormy and severe weather. Nevertheless, over the greater part of the State they are out in numbers every month of the year.

The time of breeding varies somewhat with the region, animals living in the north and in the mountains breeding later than those in the hot country. The young are usually born in April or May. Females containing young have been killed at various dates from March 12 to May 12, and young old enough to run about are sometimes common in April. The number of young at a birth is usually 5 or 7.

Ground squirrels are good to eat, and a few years ago were regularly sold in the San Francisco markets. They have always been prized by the Indians, who roast them over the coals and devour them eagerly. Old animals at times have a rather strong flavor, but the young of the year are usually tender and delicious.]

MEANS OF DESTRUCTION.

Among the means of destruction not to be lost sight of are the natural enemies—especially coyotes, badgers, foxes, and the golden eagle.

Ground squirrels may be shot, trapped, poisoned, or they may be killed by certain gases—notably fumes of bisulphid of carbon or burning sulphur—forced into their burrows.

Trapping.—Various traps have been used with success. The ordinary No. 0. steel trap placed unbaited in the mouths of the burrows sometimes yields excellent results, but the best and most humane trap in use at the present time is the so-called guillotine trap—a trap which kills the animal instantly by striking it a heavy blow on the back of the neck. Any food attractive to the squirrels may be used for bait; dried prunes and pieces of sugar beet have proved particularly successful.

Poisoning.—For poisoning the following formula is recommended:

Strychnia sulphate	1 ounce.
Borax	2 ounces.
Crushed wheat, rolled oats, acorn meal, or corn meal	20 pounds.

Dissolve the strychnine and borax in 2 quarts of hot water in a closed vessel, stirring occasionally for twenty minutes or until completely dissolved. Then add 4 quarts warm water (in which one-fourth pound of honey may be dissolved) and sprinkle the solution over the crushed grain or meal, stirring or mixing thoroughly until absorbed. Half a teaspoonful of this should be placed close to the entrance of each occupied burrow.

Poisoned whole grain sown broadcast is effective, but kills so many doves, larks, quail, and other valuable birds that it is not recommended.

Ordinary wheat flour and pulverized strychnine, in the proportion of 1 ounce of strychnine to 20 pounds of flour, mixed dry, has proved efficient in the case of the large Columbia ground squirrel of eastern Washington and is worth trying in California.

Cut pieces of carrot and sugar beet into which crystals of strychnine have been introduced serve admirably to destroy the squirrels in gardens and orchards, but their preparation involves too much labor to be profitable where poisoning on a large scale is necessary.

Phosphorus and cyanide of potassium, owing to the great danger attending their use, are not recommended.

Bisulphid of carbon.—Crude bisulphid, suitable for killing prairie dogs and other burrowing animals, costs about 8 cents per pound in 50-pound carboys or drums. It is a volatile liquid and rapidly loses strength on exposure to the air; hence, it should be kept in tightly corked bottles or cans. It should not be introduced haphazard, but should be used only in burrows where the animals have been seen to enter immediately before it is applied, so that none may be wasted on unoccupied holes. It should be employed in the following manner:

A tablespoonful of crude bisulphid should be poured on a piece of horse manure, corncob, lump of earth, or other absorptive material; this should be thrown as far as possible down the burrow and the opening should be closed immediately. Bisulphid can be used to best advantage after a rain, when the interspaces in the soil are filled with water, so that the fumes are less readily diffused into the surrounding ground.

UNITED STATES.

[Reports to the Surgeon-General, Public Health and Marine-Hospital Service.]

Report from San Francisco, Cal.—Plague-prevention work at San Francisco, Oakland, and Point Richmond, and in Alameda and Contra Costa counties, Cal.—Plague rat found at Oakland.

Passed Assistant Surgeon Blue reports:

SAN FRANCISCO, CAL.

Week ended December 12.

Last case of human plague	Sickened, January 30, 1908
Sick inspected	5
Plague	0
Dead inspected	100
Plague	0
Necropsies held	6
Premises inspected	11,707
Houses disinfected	19
Houses destroyed	1
Buildings condemned	17
Nuisances abated	1,129
Rats found dead	77
Rats trapped	1,991
Total rats taken	2,068
Rats identified:	
Mus norvegicus	1,374
Mus rattus	44
Mus musculus	600
Total	2,018